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How can interactive multimedia direct instruction model improve student cognitive learning outcomes?

Adam Malik [1, a] *, Ayu Wandira [1, b], Dedi Kuntadi [1, c], Andi Rohendi Nugraha [2, d]

[1] UIN Sunan Gunung Djati Bandung. Jl. A.H Nasution No.105, Cibiru, Bandung 40614, Indonesia
[2] University of Hamburg. Mittelweg 177, 20148 Hamburg Germany
[a] adammalik@uinsgd.ac.id; [b] wandiraayu117@gmail.com; [c] dedikuntadi@uinsgd.ac.id;
[d] andi.rohendi.nugraha@studium.uni-hamburg.de
* Corresponding Author.

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Abstract: This study aims to determine the implementation of the direct instruction model based on interactive multimedia and the lecture model as well as the differences in the improvement of students' cognitive learning outcomes after the two models are applied to the material of effort and energy. The method in this study uses a quasi-experimental method, with a Noneequivalent Control Group design. The research sample consisted of two classes, namely class X-IPA 1 as the experimental class and class X-IPA 2 as the control class, each consisting of 20 students. Data on the implementation of learning were obtained through observation sheets and students' cognitive learning outcomes were obtained through multiple-choice tests. The data analysis technique used the calculation of the observation sheet, N-gain, and t-test. The results showed that the average percentage of all meetings on the implementation of learning in the experimental class was 82.78% with very good interpretation and 71.85% in the control class with good interpretation. The increase in students' cognitive learning outcomes in the experimental class was 0.58 in the medium category and in the control class was 0.29 in the low category. The results of hypothesis testing using an independent sample t-test showed the value of t_{count} (3.56) > t_{table} (2.02). The results showed that there were differences in the cognitive learning outcomes of students who studied with an interactive multimedia-based direct instruction model and lecture model. Thus, the interactive multimedia-based direct instruction model is better in improving students' cognitive learning outcomes in the matter of effort and energy. This study could be implemented in schools with proper or non-proper laboratory facilities for supporting the learning of physics.

Keywords: Cognitive Learning Outcomes; Direct instruction Based on Interactive Multimedia; Lecture Model

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Introduction

Education essentially provides an environment that can enable students to develop their interests and talents (Picciano, 2021). The essence of education is the teaching and learning process (Picciano, 2021). The teacher's role in the teaching and learning process is very important in creating an interesting and effective atmosphere by using various types of learning resources. Thus, students can receive maximum learning.

Students' cognitive learning outcomes in physics subjects are still low because when it takes place only one-way communication occurs and does not involve students in the process (Fayanto, Musria, et al., 2019). Student learning outcomes do not reach the KKM set by the school because the learning model used by the teacher is less varied and tends to be monotonous (Mulyono, 2017). In addition, Putranta & Jumadi (2019) stated that low student learning outcomes are influenced by internal factors (learning motivation, enthusiasm for learning and learning intensity) and external factors (school environment and technological progress).

Physics learning so far shows that the learning model that is usually implemented using the blackboard and student handbooks is still often used. Observations of the learning process in several randomly selected schools in Bandung proves that the commonly applied model does not make students more active. Sometimes, teachers ask questions that only a few students can answer. Meanwhile, students tend to only listen to the teacher's explanation. As a result, the enthusiasm of students in participating in learning is still lacking. Such learning patterns cause student learning outcomes to be less than optimal. This finding is in line with Malik's research in 2020 which proves that the model that is usually applied must be changed to a relevant model that makes students more active and think scientifically.

Moreover, the commonly applied models used for a long time are no longer relevant to the current conditions of students and learning, so that there is no more enthusiasm for students during the learning process. The findings of previous research showed that low enthusiasm was caused by less interesting learning and the dominant delivery of material using the blackboard media (Suhendi et al., 2018). In addition, learning that only emphasizes the ability of students to answer questions and memorize formulas makes learning difficult.

The direct instruction model supports student learning processes related to declarative knowledge and structured procedural knowledge that can be taught in stages (Tunde & Listiani, 2021). The direct teaching model assumes that all students can learn new material when they master the initial knowledge and skills and when the instructions given are clear (Stockard et al., 2018). The results of previous studies regarding the direct teaching model show that this model is oriented towards structured academics. This model is considered the right and best model to be taught to students compared to other teaching models because it can encourage students to build their own knowledge and is the most effective model for measuring the achievement of basic skills in understanding a material. In addition, several advantages of the direct instruction model include: (1) it can emphasize important points, (2) it is an effective way to teach concepts and skills to low-achieving students, (3) it can help students learn more quickly and efficiently, and 4) it is a solution to overcome conceptual understanding (Tunde & Listiani, 2021).

Previous research has shown that the direct instruction model can significantly improve student learning outcomes (Stockard et al., 2018). The novelty of this research is the application of a multimedia-based direct learning model which is expected to make learning more interactive. Students can be more active in participating in learning so that learning outcomes can be better. This is in accordance with the opinion of Setya & Zakwandi (2019) that the use of media in learning can generate desire, interest, motivation and stimulation of learning activities. Interactive multimedia is effective in improving student physics learning outcomes.

The interactive multimedia used in this research is interactive power point. It can make students not only see or hear the teacher's explanation but can combine the two and can directly practice the material explained by the teacher. As a result, learning will be more interactive and not only focusing on the teacher. In addition, since students are directly involved in learning, they better understand what is conveyed by the teacher. A person can only remember 20% when he sees and 30% when he hears. However, one can remember 50% when he sees while hearing and 80% when he sees, hears and practices it. In addition, the use of power point media can increase student interest, motivation, and learning outcomes.

The power point used in this research is made as attractive as possible which includes text, images, animation, audio, and video. This can help in visualizing the concepts being studied so that students can more easily understand the material. Each slide contained in the PowerPoint contains important points about the material being taught. The pictures/animations contained in the power point are made to make it easier for students to visualize phenomena related to the concepts being studied. The video contained in PowerPoint is a simulation video that can encourage students to do simple practices. Then, each power point slide contains several questions about the concepts being studied. In addition, PowerPoint is equipped with an application to calculate the work and energy created using the VBA macro feature in PowerPoint.

In the end, with the implementation of the direct instruction learning model assisted by interactive multimedia, it is hoped that it can foster student interest and motivation so that students' cognitive learning outcomes can increase. Thus, this study aims to determine the application of the interactive multimedia-based direct learning model and the lecture model as well as the differences in the improvement of students' cognitive learning outcomes after the two models are applied to the material of effort and energy.

Methods

The method used in this study is a quasi-experimental method with Nonequivalent Control Group Design (Table 1). This design is almost the same as the pretest-posttest control group design, except that in this study the experimental group and control group were not chosen randomly (Jha, 2014).

Table 1. Research Design

Group	*Pretest*	Learning	*Posttest*
Experiment	O1	X1	O2
Control	O3	X2	O4

The population in this study were all students of class X Senior Hight School in Bandung. The research sample was determined using a random sampling technique (Thompson, 2012). The samples selected were class X-IPA 1 and class X-IPA 2 at SMAI Yappas Al-Barokah. Class X-IPA 1 was used as an experimental class with 20 students consisting of 16 girls and 4 boys. Class X-IPA 2 was used as a control class with 20 students consisting of 15 girls and 5 boys. The material given during the research is about work and energy. Work and energy of matter are divided into four sub-materials, namely work and energy, the relationship between work and energy, power, and the law of conservation of mechanical energy.

The instruments used in this study consisted of observation sheets to obtain data on the implementation of interactive multimedia-assisted direct learning models and implementation models commonly applied to business and energy materials. The observation sheet is made based on the steps of the direct instruction model for the experiment class which consists of: Stage 1 to convey goals and prepare students, Stage 2 to demonstrate knowledge, Stage 3 to guide training, Stage 4 to check understanding and feedback, and Stage 5 to provide follow-up practices (Polonia & Ravi, 2020). Learning in the control class is made based on the model steps commonly applied to the lecture method which consists of conveying objectives, presenting information, checking understanding and feedback, and providing Advanced Training (Suratno, 2018). The observation sheet is filled out by students and teachers by marking a checklist for each stage which is assessed using a Likert measurement scale. Answers are given a score of 1-5 with the criteria of very poor to very good. The results of the calculation of the entire implementation of teacher and student activities are processed and calculated in the form of percentages which are then interpreted as results. The implementation criteria for each meeting are shown in Table 2.

Table 2. Criteria for Implementation of Each Meeting (Malik et al., 2020)

Syntac implementation (%)	Interpretation
0 - 20	Very Poor
21 - 40	Poor
41 - 60	Enough
61 - 80	Good
81 - 100	Very Good

The test of students' cognitive learning outcomes was conducted to determine the significance of students' cognitive learning outcomes on the material of effort and energy. Pretest and Posttest in the form of multiple choice with a total of 20 questions. The indicator of cognitive learning outcomes measured refers to the revised Bloom's Taxonomy which consists of six categories, namely: remembering, understanding, applying, analyzing, evaluating and creating (Anderson & Krathwohl, 2001). Guidelines for assessing cognitive learning outcomes test using a score given for each question, namely 0 if the answer is wrong and 1 if the answer is correct. The test instrument was used to test the validity of the tests carried out. The test results data were analyzed using the software program Anates 4.0.9. The increase in cognitive learning outcomes is calculated using the N-gain formula. Hypothesis testing is done by using statistical test techniques in accordance with the distribution of the data obtained. Processing and calculating data using Microsoft excel program where before testing the hypothesis, the normality test and homogeneity test are carried out first.

Result and Discussion

Result

Based on the results of student and teacher answers on the observation sheet for each meeting, the implementation of the direct instruction model assisted by interactive multimedia is presented in Table 3.

Table 3. Implementation of Direct Instruction Model Learning Assisted by Interactive Multimedia Every Meeting

Meeting-	Percentage of Implementation(%)	Interpretation
1	77.60	Good
2	85.60	Very Good
3	88.43	Very Good
Average	83.88	Very Good

The percentage of learning implementation using the interactive multimedia-assisted direct instruction model increased at every meeting. The average implementation of learning as a whole is 83.88%. The lowest percentage of implementation of learning is the first meeting of 77.60% with a good interpretation, while the highest percentage of implementation is the third meeting of 88.43 with a very good interpretation.

The overall implementation of each stage of the interactive multimedia-assisted direct instruction model can be seen in Table 4.

Table 4. Implementation of Each Stage of Learning Direct Instruction Model Assisted by Interactive Multimedia

No.	Syntax	Percentage of Implementation(%)	Interpretation
1.	Classification of goals and motivation	88.72	Very Good
2.	Presenting knowledge	85.50	Very Good
3.	Provide guided practice	79.86	Good
4.	Check understanding and feedback	78.09	Good
5.	Provide advanced training	84.90	Very Good
6.	Closing	84.00	Very Good
	Average	83.51	Very Good

The average implementation of each stage of learning the direct instruction model assisted by interactive multimedia as a whole is 83.51%. The lowest percentage of implementation of the learning stage is the stage of checking understanding and feedback of 78.09%, including well interpreted. The highest percentage of the implementation of the learning stages is the goal and motivation classification stage of 88.72% with a very good interpretation.

The implementation of learning using the usual implemented model with the lecture method based on the results of student and teacher answers on the observation sheet for each meeting is presented in Table 5.

The percentage of implementation of learning with usual implemented models with the lecture method has increased at each meeting. The average implementation of learning as a whole is 67.40%. The lowest percentage of learning implementation is the first meeting of 61.61% with a good interpretation. The highest percentage of implementation is the third meeting of 71.84 with a good interpretation.

Table 5. Implementation of the Usual implemented Model in Every Meeting

Meeting-	Percentage of Implementation(%)	Interpretation
1	61.61	Good
2	68.75	Good
3	71.84	Good
Average	67.40	Good

The implementation of each stage of the usual implemented model with the lecture method as a whole can be seen in Table 6.

Table 6. Implementation of Each Stage of the Usual implemented Model

No.	Syntax	Percentage of Implementation(%)	Interpretation
1.	Delivering goals	76.74	Good
2.	Presenting information	72.92	Good
3.	Check understanding and feedback	64.84	Good
4.	Provide advanced training	75.10	Good
5.	Closing	72.63	Good
	Average	72.44	Good

The average implementation of each stage of learning the usual implemented model with the lecture method as a whole is 83.51%. The lowest percentage of implementation of the learning stage is the stage of checking understanding and feedback of 64.84% which is interpreted well. The highest percentage of the implementation of the learning stages is the stage of classification of goals and motivation of 76.74% with good interpretation.

Learning outcomes in the experimental class using the interactive multimedia-assisted direct instruction model and in the control class using the usual implemented model were measured using a test of 20 questions with the material of effort and energy. The learning that has been carried out in both groups can be seen from the pretest, posttest and N-gain scores which have been analyzed quantitatively. The results of the quantitative analysis obtained by the researcher are shown in Table 7.

Table 7. Quantitative Analysis Results

Classes	Average			Interpretation
	Pretest	Posttest	N-gain	
Experiment	20.75	66.50	0.58	Moderate
Control	27.50	48.75	0.29	Low

The experimental class N-gain value is 0.58 and the control class N-gain value is 0.29. This shows that there is an increase in cognitive learning outcomes in both the experimental class and the control class. However, the increase in cognitive learning outcomes of experimental class students was higher, including moderately interpreted compared to the control class, including low interpretation.

In addition, the N-gain value of the experimental class and the control class can also be classified based on gender which can be seen in Table 8.

Table 8. N-gain data by gender

Gender	Average							
	Experiment class				Control Class			
	Pretest	*Posttest*	*N-gain*	Interpretation	*Pretest*	*Posttest*	*N-gain*	Interpretation
Female	19.69	66.56	0.59	Moderate	27	44	0.23	Low
Male	25.00	66.25	0.57	Moderate	28	63	0.49	Moderate

The N-gain value of female students and male students in the experimental class was not much different. The increase in learning outcomes for female students (0.59) is greater than male students

(0.57). The increase in the learning outcomes of female and male students in the experimental class is moderate. Meanwhile, in the control class, the increase in female student learning outcomes by 0.23 is low. The increase in student learning outcomes for male students is 0.49 which is moderately interpreted.

The results of the sub-material scores can be used to see the average value of the pretest, posttest, and N-gain. The average values of pretest, posttest, and N-gain for each sub-material of work and energy are in Table 9.

Table 9. The Average Value of Pretest, Posttest, and N-gain for Each Sub-Material of Work and Energy

Sub Topic	Average							
	Experiment Class				Control Class			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Work	25	76	0.68	Moderate	36	65	0.45	Moderate
Energy	12	73	0.69	Moderate	30	49	0.27	Low
Work and Energy relationship	15	37	0.49	Moderate	14	27	0.28	Low
Power	14	36	0.48	Moderate	15	20	0.11	Low
Mechanical conservation law	17	44	0.43	Moderate	15	34	0.29	Low
Average	16.6	53.2	0.55	Moderate	22	39	0.28	Low

The average value of N-gain for each sub-material of work and energy in the experimental class is 0.55, which is interpreted as moderate. While in the control class 0.28 is interpreted as low. The lowest value of N-gain sub-material in the experimental class is in the law of conservation of mechanical energy of 0.43 which is moderately interpreted. While in the control class, there is a power sub of 0.11 which is interpreted as low. The highest sub-material N-gain value in the experimental class was found at an energy of 0.69 which was interpreted as being. While in the control class there is a business sub material of 0.45 which is moderately interpreted.

The average value of pretest, posttest, and N-gain for each sub-material can also be classified by gender, which can be seen in Table 10.

Table 10. The Average Value of Pretest, Posttest, and N-gain in Experimental Class of Each Sub-Material Based on Gender

Sub Topic	Average							
	Female				Male			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Work	20	61	0.51	Moderate	5	19	0.15	Low
Energy	8	56	0.52	Moderate	4	20	0.17	Low
Work and Energy relationship	13	31	0.38	Moderate	2	9	0.12	Low
Power	9	29	0.39	Moderate	5	9	0.07	Low
Mechanical conservation law	13	36	0.34	Moderate	4	11	0.09	Low
Average	12.6	42.6	0.43	Moderate	4	13.6	0.12	Low

The average value of N-gain for each sub-material of work and energy based on gender in the experimental class for female students is 0.43 which is interpreted as moderate. Meanwhile, for male students, 0.12 is interpreted as low. The lowest N-gain value for female students is found in the law of conservation of mechanical energy of 0.34 which is interpreted as moderate. Meanwhile, male students are found in the sub-material of 0.07, which is interpreted as low. The N-gain value of the highest sub-material of female students and male students is the same in energy. However, the N-gain value of female students was higher, namely 0.52, which was interpreted as being moderately compared to male students, which was 0.17, which was interpreted as low.

The average value of N-gain for each work and energy sub-material based on gender in the control class is shown in Table 11. The average value of N-gain for each sub-material of work and energy based on gender in the control class for female students is 0.15, which is interpreted as moderate. Meanwhile, for male students, 0.09 is interpreted as low. The lowest N-gain value for female students (0.08) and male students (0.02) is the same in the low-interpreted power sub-material. The highest N-gain value for female students is the sub-material of the law of conservation of mechanical energy of 0.21 which is interpreted low. Meanwhile, male students, namely the business sub-material of 0.17, have a low interpretation.

Table 11. Average Value of Pretest, Posttest, and N-gain of Control Class for Each Sub-Material Based on Gender

Sub Topic	Average							
	Female				Male			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Work	26	40	0.19	Low	10	25	0.17	Low
Energy	23	34	0.14	Low	7	15	0.09	Low
Work and Energy relationship	13	19	0.13	Low	1	8	0.12	Low
Power	11	15	0.08	Low	4	5	0.02	Low
Mechanical conservation law	9	24	0.21	Low	6	10	0.05	Low
Average	16.4	26.4	0.15	Low	5.6	12.6	0.09	Low

The increase in students' cognitive learning outcomes in the matter of effort and energy can be seen from each indicator of the cognitive aspect based on Bloom's revised taxonomy. The average value of pretest, posttest and N-gain for each indicator of students' cognitive learning outcomes can be seen in Table 12.

Table 12. The Average Value of Pretest, Posttest and N-Gain for Each Indicator of Cognitive Learning Outcomes

Cognitive Level	Average							
	Experiment Class				Control Class			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Remembering (C1)	5	32	0.77	High	19	28	0.43	Moderate
Understanding (C2)	9	35	0.51	Moderate	14	22	0.17	Low
Applying (C3)	26	73	0.64	Moderate	26	54	0.38	Moderate
Analysing (C4)	22	65	0.55	Moderate	33	47	0.21	Low
Evaluating (C5)	13	32	0.40	Moderate	15	25	0.22	Low
Creating (C6)	8	29	0.66	Moderate	3	19	0.43	Moderate
Average	13.83	44.33	0.59	Moderate	18.33	32.50	0.31	Moderate

The average N-gain value for each indicator of students' cognitive learning outcomes in the experimental class as a whole is 0.59, which is interpreted as moderate. Meanwhile, in the control class, 0.31 is also interpreted as moderate. The lowest N-gain value of the cognitive indicator in the experimental class is found in the evaluating indicator of 0.40, which is interpreted as moderate. While in the control class there is an understanding indicator of 0.17 which is interpreted as low. The N-gain value of the highest cognitive learning outcome indicator in the experimental class was found in the remembering indicator of 0.77 which was interpreted as high. While in the control class there is an indicator of remembering at 0.43 which is interpreted moderate.

The increase in each indicator of students' cognitive learning outcomes based on gender in the experimental class is shown in Table 13.

Table 13. The Pretest, Posttest and N-gain of Each Indicator Based on Gender in the Experimental Class

Cognitive Level	Average							
	Female				Male			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Remembering (C1)	5	26	0.60	Moderate	1	6	0.13	Low
Understanding (C2)	5	27	0.40	Moderate	4	8	0.07	Low
Applying (C3)	20	59	0.49	Moderate	8	14	0.07	Low
Analysing (C4)	18	52	0.41	Moderate	4	13	0.09	Low
Evaluating (C5)	8	25	0.33	Moderate	5	7	0.04	Low
Creating (C6)	7	24	0.52	Moderate	1	5	0.10	Low
Average	10.50	35.50	0.46	Moderate	3.83	8.83	0.08	Low

The average N-gain value for each indicator of cognitive learning outcomes based on gender in the experimental class for female students is 0.46, which is interpreted as moderate. Meanwhile, for male students, 0.08 is interpreted as low. The value of the N-gain indicator of the lowest cognitive learning outcomes for female students and male students is the same in the evaluation indicator. The N-gain value of 0.33 is interpreted as moderate for female students and 0.04 is interpreted low for male students. The value of the N-gain indicator of the highest cognitive learning outcomes for female students and male students is the same in the memory indicator. The N-gain value of 0.60 is moderately interpreted for female students and 0.13 is interpreted low for male students.

The increase in each indicator of students' cognitive learning outcomes based on gender in the control class is shown in Table 14.

Table 14. The Pretest, Posttest and N-gain of Each Indicator Based on Gender in the Control Class

Cognitive Level	Average							
	Female				Male			
	Pretest	*Posttest*	N-*gain*	Interpretation	*Pretest*	*Posttest*	N-*gain*	Interpretation
Remembering (C1)	14	21	0.27	Low	5	7	0.06	Low
Understanding (C2)	10	13	0.06	Low	4	9	0.09	Low
Applying (C3)	20	37	0.21	Low	6	17	0.12	Low
Analysing (C4)	23	32	0.12	Low	10	15	0.06	Low
Evaluating (C5)	13	16	0.06	Low	2	9	0.12	Low
Creating (C6)	2	13	0.29	Low	1	6	0.13	Low
Average	13.67	22.00	0.17	Low	4.67	10.50	0.09	Low

The average N-gain value for each indicator of student cognitive learning outcomes based on gender in the control class for female students is 0.17, which is interpreted as low. Meanwhile, for male students, 0.09 is interpreted as low. The N-gain value of the lowest cognitive indicator of female students is found in the understanding and evaluating indicator of 0.06 which is interpreted as low. Meanwhile, male students were found in the remembering and analyzing indicators of 0.06 which were interpreted as low. The value of the N-gain indicator of the highest cognitive learning outcomes of female students and male students is the same in the indicator of creating. The increase in cognitive learning outcomes for female students is 0.29 and 0.13 for male students is interpreted as low.

Research hypothesis testing was conducted to determine the significance of the difference in the improvement of students' cognitive learning outcomes. The steps to test the hypothesis consist of normality test, data homogeneity test, and hypothesis testing.

The normality test aims to determine whether or not a research data is normal or not. The normality test was carried out on the results of the pretest and posttest using the Lilifors test with a significance level (α) of 0.05. Calculation of normality test results can be seen in Table 15.

Table 15. Normality Test

Criteria	Experiment Class		Control Class	
	Pretest	*Posttest*	*Pretest*	*Posttest*
N	20	20	20	20
Max	45	90	45	85
Mean	20.75	665.	27.5	48.75
SD	10.92	13.77	9.93	17.09
L_{count}	0.177	0.13	0.125	0.137
L_{table}	0.19	0.19	0.19	0.19
Result	$L_{count} < L_{table}$	$L_{count} < L_{table}$	$L_{count} < L_{table}$	$L_{count} < L_{table}$
Criteria	Normal distributed	Normal distributed	Normal distributed	Normal distributed

The homogeneity test was carried out with the aim of knowing the pretest and posttest data in the experimental and control classes were homogeneous or not. The results of the homogeneity test calculation can be seen in Table 16.

The research data in the experimental and control classes showed normal and homogeneous distribution. Thus, the hypothesis testing used is the independent sample t test. The test is carried out with the aim of knowing whether the hypothesis is accepted or rejected by the researcher. The results of the hypothesis test are shown in Table 17.

Table 16. Homogenity test

Caregory	Pretest	Posttest
N	40	40
SD 1 $(S1)^2$	10.92	13.77
SD 2 $(S2)^2$	9.93	17.54
F_{count}	1.21	1.62
F_{table}	2.17	2.17
Result	$F_{hitung} < F_{tabel}$	$F_{hitung} < F_{tabel}$
Criteria	Homogent	Homogent

Table 17. Hypothesis Testing

Criteria	Result
$\bar{x}_1 - \bar{x}_2$	17.75
S_p	15.77
$\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}$	0.32
t_{count}	3.56
t_{table}	2.02
Result	$t_{count} > t_{table}$
Criteria	Ho accepted and Ha rejected
Explanation	There are differences in the improvement of students' cognitive learning outcomes

Based on the calculations obtained t_{count} (3.56) > t_{table} (2.02). Thus, it can be concluded that there are differences in students' cognitive learning outcomes in the experimental class and the control class.

Discussion

The percentage of implementation of the direct instruction model assisted by interactive multimedia and the usual implemented model with the lecture method for three meetings as a whole has increased at each meeting. This is because at each meeting reflection activities are carried out so that problems that arise in previous meetings can be corrected little by little. This is in accordance with study which stated that through reflection activities you can find facts about the strengths and weaknesses in the field and use them as material to improve the quality of teaching (Kim, 2020; Longhurst et al., 2020).

The learning activities of the interactive multimedia-assisted direct instruction model and the usual implemented model with the highest lecture method overall are the same, namely at the stage of goal classification and motivation. This shows that educators have been able to carry out each stage in the classification phase of goals and motivation well. At this stage, the student's response to learning is very good, this can be seen from when the educator greets the students at the same time answering the teacher's greeting, when the educator checks the presence of students raising their hands and answering attendance, and when the educator gives apperception and motivation in the form of student actively answering these questions. The stages of classification of goals and motivation in learning are very important in preparing students to learn, especially in giving apperception and motivation. Giving apperception before the learning process takes place has enormous benefits for student learning readiness, where apperception can generate enthusiasm, curiosity and motivation from within students to take part in learning. Students will find it easier to absorb the learning material that will be delivered (Rohmah et al., 2020; Sajiman & Hasbullah, 2021). In addition, providing motivation before learning takes place can increase students' interest and interest in the material to be studied (Makransky et al., 2019; Parong & Mayer, 2018).

The learning activities of the interactive multimedia-assisted direct instruction model and the usual implemented model with the lowest lecture method overall are the same, namely at the stage of checking understanding and feedback. This is because students still have difficulty in doing the tasks given by the teacher. Students are still shy in communicating the results of discussions and expressing opinions so that the activities at this stage run passively. In addition, the provision of feedback by educators is still not optimal. Giving feedback is influenced by several factors, namely the individual characteristics of students, the type and complexity of the case, and the type of error (Makransky et al., 2019; Parong & Mayer, 2018).

The advantage of the interactive multimedia-assisted direct learning model during the research is that it makes learning more interesting. Students are more enthusiastic when learning and easier to understand the material and physics concepts being taught. Thus, students' cognitive learning outcomes are better than before. This is because learning is designed as attractive as possible with the help of interactive power points. Interactive power points contain pictures and videos that can visualize phenomena related to the physics concepts being studied. Students can more easily understand the material and concepts being taught. Students can obtain visual and audio information. Learning is more interesting and can increase students' interest in learning. Power point slides can make it easier for teachers to combine visual and verbal information that can lead to better learning (Uzun & Kilis, 2019).

The lack of interactive multimedia-assisted direct instruction model during the research stems from the activities of teachers and students. At the beginning of learning activities there are still students who are less active, have difficulty in working on the questions given by the teacher, and do not raise complex problems. Students have difficulty in solving complex problems. This deficiency is natural because the success of learning the direct instruction model assisted by interactive multimerdia depends on the teacher's ability to convey the material and the students' ability to process the information obtained. The disadvantage of the direct instruction model is that it relies on the ability of students to assimilate information and the success of learning strategies depends on the ability of the teacher.

There is a difference between the experimental class and the control class in improving students' cognitive learning outcomes. The experimental class has a higher score than the control class. In other words, the implementation of the interactive multimedia-assisted direct instruction model in the experimental class has a better impact on improving students' cognitive learning outcomes compared to the usual implemented model. This is because learning using the direct instruction model assisted by interactive multimedia is more structured and gradual. The direct instruction model is designed to increase students' factual and procedural knowledge through gradual learning (Warju et al., 2020). In addition, by applying interactive multimedia to the direct instruction model, students do not only listen to the teacher's explanation. Students can see the phenomenon directly through the illustrated pictures presented by the educator. Students can apply directly by working on the questions and problems presented by the educator. Learning is more effective and it is easier for students to understand the material presented by the teacher. Multimedia can present information that can be seen, heard and done, so that learning becomes more effective. In addition, the use of multimedia in learning can increase students' motivation and learning outcomes (Zainuddin et al., 2019).

Learning using usual implemented models makes students passive in the learning process because students are less involved in learning. Learning using usual implemented models tends to make students passive. Students only follow the teacher's way of solving problems without looking at other references, and do not invite students to be directly involved in the learning process (Yuliana et al., 2017). In addition, usual implemented learning models cannot facilitate in developing students' critical thinking skills which results in low student achievement (Jatmiko et al., 2018).

The increase in cognitive learning outcomes of female students was greater than that of male students in the experimental class. On the other hand, the increase in cognitive learning outcomes in the control class of female students was smaller than that of male students. Based on this, in this study gender does not affect students' cognitive learning outcomes. These results strengthen the results of previous studies, gender does not affect cognitive learning outcomes. The absence of gender influence is caused by the character of the applied learning strategies and the syntax of the applied learning.

Improving students' cognitive learning outcomes in the experimental class in the energy sub-material has the highest value among other sub-materials. This is because the energy sub-material is easy to understand, closely related to everyday life, and is systematically trained at each stage of the model. This result is in accordance with previous research which showed that the concept of energy is considered as an easy matter compared to other concepts. The lowest increase in students' cognitive learning outcomes was obtained in the sub-material of the law of conservation of mechanical energy. Students are less able to apply the law of conservation of mechanical energy. Students have difficulty in answering questions because there are many components that must be known in answering questions. In addition, questions related to the law of conservation of mechanical energy are included in the category of higher order thinking abilities. These results strengthen previous research, the concept of work and energy that is the most difficult for students is the mechanical energy of the system. This opinion is also supported by research results Elisa et al, (2019) who also stated that conservation of mechanical energy was the most difficult concept for students.

The increase in cognitive learning outcomes in the control class is the highest in the business sub-material. The business material is easy to understand, closely related to everyday life, is the basic sub-material of the whole business and energy material. Improved cognitive learning outcomes in the lowest control class in the power sub-material. Students are less able to identify questions and apply the concept of the relationship between power and effort. In addition, most of the questions related to the concept of power are related to electricity. These results are in accordance with the results of previous studies. Students have difficulty in answering power questions related to electricity. Students' low concept understanding causes misconceptions (Riantoni et al., 2017). In addition, students have difficulty connecting the concept of power with the concept of work-energy (Oktaviani et al., 2018).

Improved cognitive learning outcomes of each sub-material of effort and energy based on gender in the experimental class and control class. The lowest increase in the sub-material of female students in the sub-material of the law of conservation of mechanical energy. Meanwhile, male students are found in the strength sub-material. The highest increase in the sub-material of female students and male students is the same, namely in the energy sub-material. While in the control class, the lowest increase in the sub-material of female students and male students was the same, namely in the sub-material of power. The highest increase in the sub-material of female students is in the sub-material of the law of conservation of mechanical energy. While the male students are in the business sub-material. Based on these results, it can be said that gender has no effect on students' cognitive learning outcomes. However, students' cognitive learning outcomes are influenced by students' ability to understand the material, the level of difficulty of the material, and students' ability to apply concepts in answering questions. This is in accordance with the results of previous studies which stated that gender had no effect on physics learning achievement and student problem solving strategies (Ince, 2018).

The increase in cognitive learning outcomes on each cognitive indicator has a different average. The indicator that has the highest increase in the experimental class and control class is the same, namely the indicator of remembering. This is because the questions made on the remembering indicator are included in the easy category, students only use memory skills to answer questions. Low-level thinking ability is the ability to know and remember a basic concept. However, the increase in the experimental class was higher than the control class. This is because in the experimental class the presentation of the material is assisted by interactive power points that can assist educators in visualizing the material. Students can more easily understand and remember the material longer than learning in the control class which only uses whiteboard media. This is in accordance with the results of previous studies which state that the use of power point media equipped with animation is very good to use because it can make students easily and clearly understand teaching materials with concrete examples (Bahri et al., 2018). In addition, the use of video-based power points can improve student learning outcomes (Anwar et al., 2020).

The indicator that has the lowest improvement in the experimental class is evaluating. This is because the questions related to evaluating indicators are considered difficult by students. The evaluation indicators include high-level cognitive levels so that in working on these questions, reasoning is needed. Higher order thinking skills (HOTS) are activities that require critical and evaluative thinking, as well as decision making and problem solving. In addition, these results strengthen previous research which stated that the percentage of students' ability to evaluate work and energy materials was still low, which was only 28% (Permatasari et al., 2018). The lowest indicator increase in the control class is understanding. Students are less able to understand the concept so that it is difficult to answer questions related to understanding the concept. The low ability of students to understand concepts occurs because learning using the lecture method is less able to explain the concepts of physics in detail. The explanation of the concept requires a real visualization. Learning using the lecture method students tend to only memorize the subject matter as facts. In addition, the material can only be temporarily memorized by students. Students cannot be helped in organizing material in memory for the long term and will reduce students' creativity. In addition, a concept will be easier to understand if it is equipped with pictures, mathematical equations, and graphs that state the relationship between variables (Theasy et al., 2018).

Indicators of students' cognitive abilities based on gender in the experimental class and control class. The increase in indicators of the lowest and highest cognitive learning outcomes for female students and male students in the experimental class is the same, namely on the indicators of evaluating and remembering. The improvement in indicators of the lowest cognitive learning outcomes for female students in the control class is an indicator of understanding and evaluating. Meanwhile, for male students, it is an indicator of remembering and analyzing. The increase in indicators of the highest cognitive learning outcomes of female students and male students in the control class is the same, namely the indicator of creating. The increase in indicators of cognitive learning outcomes for each indicator of students' cognitive abilities is not influenced by gender but is influenced by students' abilities and the level of difficulty of the questions. This result is in accordance with previous research which stated that there was no difference in ability between men and women. In general, there were no differences between men and women in overall IQ, learning, memory, problem solving and concept formation. Gender factor is not the only aspect of measuring student achievement (Rizal et al., 2017).

The results of hypothesis testing using the t-test independent sample test show that $t_{count} > t_{table}$, there is a difference between the application of the interactive multimedia-assisted direct instruction model and the usual implemented model on student learning outcomes in the matter of effort and energy. These results strengthen the results of previous studies that the learning model using the media-assisted direct instruction model is better than the usual implemented model in improving student learning outcomes. In addition, the use of multimedia is very suitable for use in physics learning can improve student learning outcomes (Fayanto, Misrawati, et al., 2019; Fayanto, Musria, et al., 2019). In addition, several studies have stated that learning using the direct instruction model is more effective than learning using the PBL model and usual implemented models in improving student learning outcomes (Fayanto, Misrawati, et al., 2019; Winarsih et al., 2019).

Limitations in this study include the observation sheet instrument used which does not measure the achievement of the teaching and learning process, the students who are less active during the learning process, the less complex problems arise, the pandemic which cause the reduced lesson hours. Based on these limitations, the solution for further research is expected to use more appropriate instruments to measure the achievement of the teaching and learning process. Teachers can make students more active when the learning process takes place. The questions are made more complex so that they can train students in solving complex problems. Finally, making appropriate learning plans so that they can use lesson hours more effectively.

Conclusions

The implementation of physics learning activities on business and energy materials has increased every meeting, using the interactive multimedia-assisted direct instruction model, which is

82.78% with very effective interpretation, while the usual implemented model is 71.85% with effective interpretation. The stage of checking understanding and feedback is the stage with the lowest average implementation. Students at this stage still have difficulty in doing the tasks given by the teacher. Students are still shy in communicating and expressing their opinions so that the activities at this stage run passively. Therefore, teachers should be able to make careful planning, vary the learning methods used, use learning methods that demand activeness and communication skills of students and be more optimal in providing feedback. The cognitive learning outcomes of students have increased after the implementation of the interactive multimedia-assisted direct instruction model of 0.58 with moderate interpretation and 0.29 with low interpretation of the usual implemented model. The results of the hypothesis test (independent sample t test) showed that there was a difference in the improvement of student cognitive learning outcomes between those who studied with the interactive multimedia-assisted direct instruction model and the ones who studied with the usual implemented model. The cognitive sub-indicator evaluates to obtain the lowest increase in learning outcomes. Therefore, to optimize students' cognitive learning outcomes in evaluating indicators, teachers must present more concepts in the form of story questions, provide contextual-related practice questions that require higher-order thinking skills.

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